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# NUEXCO

DECEMBER 1981 NUMBER 160

# Monthly Report on the Uranium Market

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MONTHLY REPORT ON THE URANIUM MARKET

December 1981 No. 160

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## *FOREWORD*

Copies of the monthly chronicle of the Exchange Value, which was mentioned in last month's Report, are now available upon request. We apologize for the delay in printing.



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*URANIUM MARKET*

## PRICING

The **Exchange Value** as of November 30, 1981 is $23.50 per pound $U_3O_8$. Although the Exchange Value has been $23.50 for five consecutive months, the current price level is significantly firmer than it was three to four months ago. Sellers are generally unwilling to undercut Exchange Value to enhance their prospects for making a sale.

The market remained active during November; while sellers actively competed for sales opportunities, they showed increased resistance to offer at current Exchange Value for future delivery, even just a few months away. In response to buyers' inquiries, Nuexco encountered only one offer for near term delivery at a price below Exchange Value. This trend can be seen as a function of both a strengthened demand sector and the lowering of interest rates which relieves some of the pressure of inventory carrying costs.

The near term market is firming both on the supply side and the demand side. The total of material available for sale, as indicated in the *Market Opportunities* section of this Report, is about 7.1 million pounds $U_3O_8$. About two-thirds of this material is being offered for sale by utilities.

The total of demand in the near term market is about three million pounds $U_3O_8$. A little more than half of the material is being sought by producers.

The **Transaction Value** remained at $24.10 for the second consecutive month. Ten transactions totaling 2.1 million pounds $U_3O_8$ are included in this month's calculation. The **Loan Use Charge Rate** remained at six percent.

The **Conversion Value** rose ten cents to $1.20 per pound U as $UF_6$. The secondary market for conversion services experienced little activity during November. Sellers were hesitant to make offers at or near $1.10 per pound U, particularly if delivery would not have been immediate. On the demand side, buyers gave some indications that they might be willing to pay slightly more than $1.10 per pound U for delivery within one year. There is also some evidence that conversion services, when priced as a component of a $UF_6$ sale, may be priced lower than when they are sold independently.

As indicated in the *Market Opportunities* section of this Report, the amount of secondary market conversion services available for delivery in the near term (within one year) increased slightly to approximately 2.6 million pounds U as $UF_6$. This available supply now outweighs demand by more than 13 to one in the near term. However, the potential sellers, for the most part, are not driven by any immediate need to "deconvert" their $UF_6$ inventories to respond to $U_3O_8$ inquiries and, thus, do not need to lower their prices in order to compete for the limited opportunities to sell conversion services.

There is one transaction reported this month. A US producer sold between 50,000 and 100,000 pounds $U_3O_8$ to another US producer with delivery to occur in 1981.

## AFRICA

**South Africa's** Electricity Supply Commission (ESCOM) recently announced that it had obtained sufficient enriched product for the first core of Koeberg unit 1. There is disagreement over the source of the enrichment, and ESCOM has denied that it came from France, the United States or South Africa itself. ESCOM's reluctance to discuss the transaction is understandable in view of the sensitive political and nonproliferation considerations associated with this matter. The enriched product will be fabricated into finished fuel by Framatome in accordance with its existing agreement with ESCOM.

In Report 159, Nuexco commented that the South Africans seemed confident about their ability to obtain necessary enrichment supplies in spite of safeguards problems. This recent announcement suggests that their confidence was well founded.

## AUSTRALIA

Mary Kathleen Uranium Ltd. (MKU) can start clearing its $20 million backlog of uranium shipments after winning an injunction against the Seamen's Union in Australian Federal Court on November 6. MKU had not shipped any of its uranium production since June this year because of union bans. With the injunction, shipping companies will again be willing to load uranium because the union is legally prevented from enforcing its ban. MKU guaranteed in court that it would not seek damages against the union.

In a recent parliamentary inquiry report, members of the Select Committee of the Legislative Council in South Australia have recommended that the State's uranium resources be developed. However, three of the six-member committee (two Australia Labor Party members and one Democrat) have dissented from the

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report and opposed uranium mining in the State. This tied vote clouds the future of the Olympic Dam copper-uranium development. The Australian Democrat holds the balance of power in the State Parliament and his vote will be crucial when the indenture agreement bill is introduced into the House before the end of the year. Western Mining Corp. Ltd. (WMC), the developer of the Olympic Dam deposit, indicated that the deposit could not be mined unless uranium was produced together with copper and gold. WMC has recently awarded the contract for the final feasibility study of its Yeelirrie development to the same firm which engineered and managed the Nabarlek uranium project for Queensland Mines Ltd.

No uranium deliveries will be made to Japan under contracts signed after 1972 until a nuclear-safeguards agreement has been negotiated, according to the Minister for Foreign Affairs.

The Ranger mine and mill was officially opened on November 20. However, three days later, it was shut down by the local Northern Territory (N.T.) government because the tailings pond did not conform to regulatory requirements. According to the local authorities, solid material in the filled pond had been evident above the water level. Regulations require that solid waste remain two meters below the surface.

The mine and mill were given permission to reopen after a few days by Ian Tuxworth, the N.T. Minister for Mines and Energy, and production is continuing. The shutdown illustrates strict implementation of the environmental regulations by the local authorities. The Ranger incident is the second of this type in the territory and will aid the case of those opposing uranium development there, and also might harden union attitudes against uranium mining and exportation. The situation could have a negative impact on uranium activities on the whole and on aboriginal negotiations presently underway between Pancontinental and the Northern Land Council.

## CANADA

On December 3, Eldorado Nuclear Ltd. announced that it is closing its Beaverlodge facility after 30 years of operation. The closing will be effective June 30, 1982. Eldorado cited the fact that Beaverlodge production is no longer economic as the reason for the move. The mine and mill will be decommissioned after shutdown. Eldorado will not have a problem honoring its existing contracts for uranium delivery because of its ownership of the Canadian stockpile.

## EUROPE

The fate of Framatome, which is owned 66 percent by Creusot Loire, 30 percent by CEA and four percent by the Empain Schneider Group companies, appears finally to have been decided. The French nuclear reactor manufacturer will not be nationalized or merged with Creusot Loire as previously considered. Instead, it will become a three-way partnership. The other partners will be its two largest shareholders, Creusot Loire and the CEA.

All important decisions within the partnership will require unanimous approval, so the structure will give the CEA a veto power it did not have previously. The French government did not allow the merger of Creusot Loire and Framatome because it did not want the state to be involved in the other activities of the Creusot Loire group. A merger also would have left Framatome vulnerable to the financial difficulties of Creusot Loire. CEA is expected to raise its Framatome shareholding to 34 percent in order to have a blocking minority.

Framatome and Novatome (the company constructing the fast breeder Super Phenix) may merge within the next two years. Framatome now holds 85 percent of Novatome; Alsthom Atlantique holds the remaining 15 percent.

Newspapers in **France** are reporting that it is almost certain that Egypt's first two reactors will be awarded to the French. The papers add that American sources believe the reasons are political and that the sales are tied to French arms contracts.

The first criticality of the Grafenrheinfeld 1300 MWe PWR unit in **West Germany** was delayed in order to make some changes to the feed water system piping. Criticality is again expected to be achieved very shortly. The plant received its license to proceed to power operations on November 13, 1981, subject to successful completion of the proper start up testing.

## FAR EAST

From time to time, there has been speculation that **Japan** might, under government auspices, initiate a program to build up its uranium inventories through large scale purchases in the spot market. For the most part, such speculation appears to be wishful thinking

on the part of uranium sellers seeking enlarged markets for excess material. These sellers enthusiastically supplied the Japanese with a rationale for such a stockpiling program, namely enhanced security of supply. Often overlooked is the fact that, in Japan, only a stockpile of enriched product provides real supply security, since a $U_3O_8$ stockpile must eventually be exported for conversion and enrichment. US sellers provided the additional rationale that Japanese purchases of US origin $U_3O_8$ would help reduce the recurrent balance of payments problems between the two countries.

Japan's Natural Resources and Energy Agency recently reviewed the uranium situation with the Japanese utility companies. They concluded that the size of the existing inventories and future deliveries under contract were such that it would be difficult to justify increased stockpiling at this time.

## SOUTH AMERICA

Approximately 80 percent of the total 1,142,000 square kilometer land base of **Colombia** has been reserved for uranium exploration and evaluation activity under the direction of the Instituto de Asuntos Nucleares (IAN). The remaining 20 percent of the land base could become available for exploration activity following staking of mining claims in accordance with the general mining laws of Colombia.

Uranium reconnaissance in the country has been conducted intermittently since 1949 through the National Geological Survey and IAN. More recently, exploration activities have increased through both independent projects performed by IAN and IAN's ongoing joint venture programs with Agip-Nucleare of Italy, Minatome and Cogema of France, and ENUSA of Spain. These projects have primarily consisted of aerial radiometric and geochemical reconnaissance. Test drilling has been completed in certain areas. Approximately 272,000 square kilometers are covered in the recent programs. Exploration expenditures exceeded US twelve million dollars during the 1980-1981 period. Exploration results have been encouraging to both IAN and the joint venture participants, confirming plans for increased exploration efforts.

## UNITED STATES

### Distribution of US Uranium Inventories

The US Department of Energy (DOE) recently conducted a survey of the uranium industry[1] to update its data on uranium inventories held by producers and electric utilities. These inventories, when combined with the DOE uranium inventory, constitute the total national uranium inventory. As of the beginning of this year, the US inventory consisted of 312 million pounds $U_3O_8$ equivalent, divided into three principal groups as shown in Table 1.

The inventory position shown in Table 1 contrasts sharply with that which the electric utilities and DOE would like to maintain, shown in Table 2.

**Table 1**

**US URANIUM INVENTORY POSITION AS OF JANUARY 1, 1981**
**(millions of pounds $U_3O_8$ equivalent)**

| | |
|---|---|
| Producers | 5.4 |
| Electric Utilities | 142.4 |
| US DOE | 163.8 |
| Total | 311.6 |

**Table 2**

**DESIRED US URANIUM INVENTORY POSITION**
**(millions of pounds $U_3O_8$ equivalent)**

| | |
|---|---|
| Producers | 5 |
| Electric Utilities | 35 |
| US DOE | 100 |
| Total | 140 |

A recent survey by Nuexco indicates that most utilities have policies or guidelines to maintain a uranium inventory (excluding material-in-process to meet schedule requirements for the next reactor reload) of about one year's requirements. The actual number varies from about six months to 18 months. A few utilities have guidelines to maintain essentially no inventory; a few other utilities have guidelines to hold inventories in excess of 18 months.

About 60 percent of the electric utilities hold inventories in the range of zero to 24 months. The other 40 percent, in the large part, have been victims of circumstances difficult to control. Early contracting

[1] "U.S. Uranium Market Developments", S.V. Krusiewski and D.C. Thomas, Department of Energy, October 1981.

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for $U_3O_8$ to meet requirements for nuclear power plants ordered in the 1972-1974 "boom" years, and subsequently delayed or cancelled, resulted in many utilities now carrying excess inventories.

The industry is improving its uranium inventory position, but as shown in the US supply-demand tables in the November 1981 Monthly Report (Report 159, Table 7, page 15), it could take approximately ten years for US utilities to improve their collective position from 5.5 years of forward consumption to 1.8 years of forward consumption. This is still short of their collective desire to hold an average inventory of one year's forward consumption. The 1981 Beginning Inventory position of 147.8 million pounds $U_3O_8$ equivalent represents only the *commercial*—producers and electric utilities—inventories and excludes the government inventories since they are not readily accessible for commercial use.

The Nuexco survey also showed that electric utilities strongly prefer to hold their inventories as $U_3O_8$. This desire has been difficult to fulfill for most utilities. Again, early contracts for conversion and, to a lesser extent, for enrichment, have forced utilities to upgrade much of their $U_3O_8$ to natural or enriched $UF_6$. Table 3 shows that 40 percent of the utility inventory is in the form of natural $UF_6$ and 30 percent is in the form of enriched $UF_6$.

The US government's inventory of approximately 164 million pounds $U_3O_8$ equivalent includes about 100 million pounds $U_3O_8$ equivalent allocated to working inventory at the DOE enrichment plants and to strategic inventories. The remaining 64 million pounds will be utilized over the next 15 years to meet the long-term requirements of government programs.

The government has no plans to sell or otherwise dispose of its uranium inventories on the commercial market. The government does maintain a policy of leasing (preferably) or selling uranium to commercial users under emergency conditions, that is when uranium is unavailable from commercial sources. This policy has never been implemented for substantial quantities of uranium. The government has sold material to small users who have encountered difficulty acquiring small quantities on the market; this is merely a convenience and has had no significant effect upon the government inventory position or the commercial market.

Lastly, the producer inventory is of little consequence. Producers deliver material to the converters in advance of title transfer to utilities; this action principally occurs from the producers' desire to operate his mill at a uniform production level. These inventories have a high turnover rate, and represent a small fraction of the total.

A detailed breakdown of the total US uranium inventory position is given in Table 3, with material shown in different forms as either material in storage, feed material, product material or in process of conversion to a different form.

**Table 3**

**TOTAL URANIUM INVENTORIES HELD IN THE US AS OF JANUARY 1, 1981**
**(millions of pounds $U_3O_8$ equivalent)**

| | |
|---|---|
| As Uranium Concentrates ($U_3O_8$) | |
| Producers | |
| Stocks stored at convertors | 5.4 |
| Electric Utilities | |
| Stocks stored at convertors | 42.9[1] |
| Subtotal: Uranium as $U_3O_8$ | 48.3 |
| As Natural Uranium Hexafluoride ($UF_6$) | |
| Electric Utilities | |
| Stocks stored at convertors | 36.5[1] |
| Stocks stored at DOE under usage agreements | 10.8 |
| Feed delivered under DOE enrichment agreements | 9.4 |
| United States Government | |
| Stocks stored at enrichment plants | 41.0 |
| Subtotal: Natural Uranium as $UF_6$ | 97.7 |
| As Enriched Uranium Hexafluoride ($UF_6$) | |
| Electric Utilities | |
| Stocks awaiting delivery at enrichment plants | 6.2 |
| Stocks stored at fabricators | 36.6 |
| United States Government | |
| Working and strategic stocks at enrichment plants | 122.8 |
| Subtotal: Enriched Uranium as $UF_6$ | 165.6 |
| Total | 311.6 |

[1]Nuexco estimate

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The data presented in the tables above is extracted from DOE publications and supplemented by Nuexco estimates based on private information in its data base. The data has a high degree of accuracy, but does not include all or part of the following inventory categories:

1. Material *owned* by US convertors and fabricators used for working inventories in their plants; the individual inventories are small due to the large amount of material stored at these sites by the electric utilities; the convertors and fabricators utilize the utility-owned material for a substantial portion of their working inventories through special provisions in the storage agreements;

2. Material stored by electric utilities at non-domestic convertor sites, such as Eldorado Nuclear in Canada and British Nuclear Fuels Ltd. in the United Kingdom, may not be fully included.

3. Large stocks of depleted uranium from the enrichment plant operations are not included since this tailing material has little commercial nuclear fuel application (except for consumption of excess SWUs as demonstrated by ENEL, the national utility of Italy, which upgraded depleted uranium to natural uranium to meet contract obligations at the Eurodif enrichment plant).

Last month's Report, number 159, incorrectly stated the operating tails assay of the DOE enrichment complex. Although the operating tails assay was correctly stated elsewhere in the article, the subject is important enough to justify correcting the error. In Report 159, on page 9, left hand column, fourteenth line from the top, the operating tails assay should read "0.20 percent $U_3O_8$," not 0.25 percent.

On October 1, 1978, DOE reduced its operating tails assay from 0.25 percent $U_{235}$ to 0.20 percent $U_{235}$. That action ended seven years of so-called split-tails operations. Under the split tails policy, DOE operated the enrichment plants at a higher tails assay than that used for enrichment transactions.

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*MARKET OPPORTUNITIES*

Market Opportunities are *active* inquiries in the uranium market to buy, sell, borrow or lend. The data presented in this section are in no way intended to be indicative of the entire uranium market for the time period covered.

## URANIUM SUPPLY

| Nuexco Reference Number | Delivery Periods* (Thousands of Pounds $U_3O_8$) 0 to 1 Year | 1 to 2 Years | 2 to 3 Years | Remarks |
|---|---|---|---|---|
| **Available for Sale:** | | | | |
| 1475 | 1000 | | | $UF_6$ |
| 1480 | 100 | 300 | 300 | |
| 1490 | 1000 | | | |
| 1575 | | | 500 | Long Term |
| 1589 | 50 | 50 | 50 | Long Term |
| 1581 | 100 | 150 | 150 | Long Term |
| 1600 | 250 | 250 | 250 | Long Term |
| 1610 | | 300 | | |
| 1637 | 500 | 500 | | |
| 1684 | 500 | | | $UF_6$ |
| 1698 | 30 | | | |
| 1738 | 750 | | | $UF_6$ |
| 1749 | 350 | 200 | 200 | |
| 1770 | 350 | | | |
| 1774 | 50 | | | |
| 1804 | 550 | | | |
| 1805 | 300 | 300 | 300 | Long Term |
| 1807 | 700 | | | |
| 1810 | | 750 | | |
| 1814 | 250 | | | |
| 1818 | 250 | 250 | 250 | Long Term |
| 1824 | 30 | | | |
| TOTAL: | 7110 | 3050 | 2000 | |
| **Available for Loan:** | | | | |
| 1695 | 225 | 325 | 325 | $UF_6$ |
| 1742 | 500 | | | |
| 1785 | 1000 | | | |
| 1815 | 1000 | | | $UF_6$ |
| TOTAL: | 2725 | 325 | 325 | |

*Measured from the date of this Report

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*MARKET OPPORTUNITIES*

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## URANIUM DEMAND

| Nuexco Reference Number | Delivery Period* (Thousands of Pounds $U_3O_8$) | | | Remarks |
|---|---|---|---|---|
| | 0 to 1 Year | 1 to 2 Years | 2 to 3 Years | |
| **Inquiries to Purchase:** | | | | |
| 1459 | | | 200 | Long Term |
| 1603 | | | 100 | Long Term |
| 1634 | | 400 | | |
| 1699 | 725 | 450 | 250 | |
| 1704 | | 200 | 200 | Long Term |
| 1724 | 650 | 500 | 500 | Long Term |
| 1732 | 50 | | | |
| 1744 | 1000 | | | |
| 1769 | 125 | | | $UF_6$ |
| 1771 | 500 | | | |
| 1775 | 20 | | | |
| 1806 | | 500 | 250 | |
| TOTAL: | 3070 | 2050 | 1500 | |
| **Inquiries to Borrow:** | | | | |
| 1621 | 300 | | | |
| 1780 | 500 | | | |
| 1812 | 1000 | | | |
| TOTAL: | 1800 | | | |

*Measured from the date of this Report.

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*MARKET OPPORTUNITIES*

Market Opportunities are *active* inquiries in the secondary market for $UF_6$ conversion services. The data presented in this section are in no way intended to be indicative of the entire market for the time period covered.

## CONVERSION SUPPLY

| Nuexco Reference Number | Delivery Period* (Thousands of Pounds U as $UF_6$) 0 to 1 Year | 1 to 2 Years | 2 to 3 Years | Remarks |
|---|---|---|---|---|
| 1451 | 75 | | | |
| 1584 | 350 | 300 | 300 | Long Term |
| 1607 | 1000 | | | |
| 1609 | 500 | 1500 | 1000 | Long Term |
| 1619 | | 250 | 50 | |
| 1661 | 200 | | | |
| 1684 | 450 | | | |
| 1764 | 100 | | | |
| TOTAL: | 2675 | 2050 | 1350 | |

## CONVERSION DEMAND

| Nuexco Reference Number | Delivery Period* (Thousands of Pounds U as $UF_6$) 0 to 1 Year | 1 to 2 Years | 2 to 3 Years | Remarks |
|---|---|---|---|---|
| 1594 | | 400 | 950 | Long Term |
| 1622 | 200 | 300 | 300 | Long Term |
| TOTAL: | 200 | 700 | 1250 | |

*Measured from the date of this Report.

*ESSAY*

## THE IMPACT OF REACTOR CANCELLATIONS

The cancellations of nuclear reactors over the past several years have often been cited as a cause of the declining uranium prices during the same period. While it is difficult to accurately quantify the impact, it is possible to approximate the amount by which cumulative demand for uranium will be reduced as a result of these reactor cancellations.

Using the Nuclear News World List of Nuclear Power Plants as a benchmark, the reactors in the US cancelled between the June 1979 and June 1981 publications are itemized in Table 4. During that time, 23 reactors comprising some 25,000 MWe were cancelled. The previously anticipated commercial operating dates ranged from late 1983 to indefinitely postponed.

From this list of cancelled reactors, a rough calculation of their impact on uranium demand can be made by using the following assumptions:

1. First core demand is assumed to be one million pounds $U_3O_8$ per 1,000 MWe and is assumed to appear two years in advance of the expected commercial operating date. This lead time accounts for the utility advance procurement policies as well as for pipeline times through conversion, enrichment, fabrication, etc.

2. Reloads are assumed to consume approximately 322,000 pounds $U_3O_8$ per 1,000 MWe, and the demand

**Table 4**

**US REACTORS CANCELLED 6/79-6/81[1]**

| Reactor | Utility | MWe | Expected Commercial Operating Date As of 6/79 |
|---|---|---|---|
| Palo Verde 4 | Arizona Nuclear Power Project | 1270 | 5-88 |
| Palo Verde 5 | Arizona Nuclear Power Project | 1270 | 5-90 |
| Pilgrim 2 | Boston Edison | 1150 | 12-85 |
| Davis Bessie 2 | CAPCO Group | 906 | 88 |
| Davis Bessie 3 | CAPCO Group | 906 | 90 |
| Erie 1 | CAPCO Group | 1260 | 4-86 |
| Erie 2 | CAPCO Group | 1260 | 4-88 |
| Greenwood 2 | Detroit Edison | 1200 | 90 |
| Greenwood 3 | Detroit Edison | 1200 | 92 |
| Forked River 1 | General Public Utilities | 1120 | 12-83 |
| Jamesport 1 | LILCO | 1150 | 88 |
| Jamesport 2 | LILCO | 1150 | 90 |
| NEP-1 | New England Power | 1150 | indef. |
| NEP-2 | New England Power | 1150 | indef. |
| Tyrone 1 | Northern States Power | 1100 | 86 |
| Montague 1 | Northeast Utilities | 1150 | indef. |
| Montague 2 | Northeast Utilities | 1150 | indef. |
| NYSEG-1 | New York State Electric & Gas | 1250 | 4-92 |
| NYSEG-2 | New York State Electric & Gas | 1250 | 4-94 |
| Bailly | NIPSCO | 645 | 84 |
| Sterling | Rochester Gas & Electric | 1150 | 4-88 |
| North Anna 4 | VEPCO | 938 | 4-87 |
| Haven 1 | Wisconsin | 900 | 6-89 |
| Total: 23 Reactors | 14 Utilities Utility Groups | 25,675 | |

[1]Units listed as on order or under construction in the June 30, 1979 Nuclear News World list of Nuclear Power Plants but not included in the same publication for June 30, 1981.

for reloads appears eighteen months in advance of the need for the first reload and annually thereafter. In cases where a year but no month is given for the Nuclear News expected commercial operating date, the analysis assumed a startup in the second half of the year.

3. Twelve month fuel cycles are assumed.

Table 5 shows the lost demand associated with the cancellations shown in Table 4. The results for the years 1991 through 1995 are grouped into one entry. Also, two of the four 1,150 MWe reactors which were indefinitely postponed as of 1979 and cancelled as of 1981 are assumed to have had late-1993 commercial operating dates; the other two are assumed to have had late 1995 commercial operating dates.

Although this model makes some large simplifications, the result is nonetheless staggering. In the last two years, reactor cancellations have eliminated more than 80 million pounds of $U_3O_8$ demand over the next 15 years.

In addition to the cancellations already announced by various utilities, Nuexco believes that there will be additional utility decisions to cancel at least fourteen reactors due to financial and political considerations. Table 6 summarizes Nuexco's estimate of the amount of generating capacity and the accompanying loss of demand represented by these probable future cancellations, using the same procurement assumptions that were used in Table 5. These anticipated cancellations represent an additional 60 million pounds of lost demand over the next 15 years.

Thus, between the reactors already cancelled and those which Nuexco estimates *probably* will be cancelled over the next few years, some 140 million pounds of demand will have been eliminated. That quantity represents more than five years' forward consumption for the US.

A utility with a cancelled reactor has limited options with respect to the supply associated with the reactor:

1. If there is no supply in inventory or under contract for the reactor, the utility may abandon plans to procure this uranium. Alternately, the utility may renegotiate to cancel its supply contract, if the supplier is willing. This will depress the longer term uranium price, because anticipated demand will not materialize.

2. If there is supply associated with the reactor, either in inventory or under contract, the utility may elect to use this uranium for other reactors it has

**Table 5**

**IMPACT OF CANCELLED REACTORS 6/79-6/81**

| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991-1995 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cancelled GWe | 0 | 0 | 1.1 | .6 | 1.2 | 2.4 | .9 | 5.7 | .9 | 4.5 | 8.3 |
| Cumulative Cancelled GWe | 0 | 0 | 1.1 | 1.7 | 2.9 | 5.3 | 6.2 | 11.9 | 12.8 | 17.3 | 25.6 |
| Lost Demand (millions of pounds $U_3O_8$) | 1.1 | 0.6 | 1.5 | 2.9 | 2.3 | 6.8 | 1.1 | 8.7 | 1.5 | 8.1 | 11.6 |
| Cumulative Lost Demand (millions of pounds $U_3O_8$) | 1.1 | 1.7 | 3.2 | 6.1 | 8.4 | 15.2 | 19.3 | 28.0 | 32.5 | 40.6 | 82.2 |

**Table 6**

**IMPACT OF FORECAST CANCELLATIONS***

| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991-1995 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cancelled GWe | 0 | 0 | 0 | 1.2 | 1.3 | 1.2 | 2.4 | 1.2 | 2.5 | 2.3 | 4.9 |
| Cumulative Cancelled GWe | 0 | 0 | 0 | 1.2 | 2.5 | 3.7 | 6.1 | 7.3 | 9.8 | 12.1 | 17.0 |
| Lost Demand (millions of pounds $U_3O_8$) | 0 | 1.2 | 1.3 | 2.0 | 3.6 | 3.1 | 1.5 | 5.5 | 5.9 | 5.2 | 27.9 |
| Cumulative Lost Demand | 0 | 1.2 | 2.5 | 4.5 | 8.1 | 11.2 | 15.7 | 21.2 | 27.1 | 32.3 | 60.2 |

*Nuexco estimates

running. This reassignment will displace the uranium needs of the other reactor(s), which, as in (1) above, will exert downward pressure on the longer term uranium market.

3. The utility may choose to sell the material designated for the cancelled reactor because of lack of need, holding costs, or a need for cash. In this case, the sale will have a direct downward impact on the market, and particularly on the spot market.

Over the last couple of years, utility inventory sales have become more frequent. While such sales have not been the sole cause of the price decline, they have made a significant impact. However, the material being sold by utilities is but a fraction of the material affected by reactor cancellations, not to mention the impact of the many delays. In most cases, utilities holding excess are handling the material in the fashions described in points (1) and (2) above. The effect of this is more subtle and difficult to perceive than that of spot sales of inventories, but the sheer magnitude of the lost demand will inevitably exert substantial resistance against any upward price movements for some time.

*COMMENTARY*

*The following is a slightly edited version of a speech given by Mr. J. Robert Wolcott, President of Nuexco, on the occasion of the Nuexco luncheon at the Atomic Industrial Forum (AIF) Annual Conference in San Francisco, November 29-December 2, 1981.*

## DILEMMAS OF NUCLEAR POWER

### Introduction

The nuclear power industry is in very difficult straits. Its problems are so deep-seated that they require a whole new conceptual approach.

A September report to the presidentially appointed Nuclear Safety Oversight Committee entitled "Governance of Nuclear Power" contains the following:

"— Over 70 nuclear power plants operating in the United States;

— Approximately 80 plants at various stages of construction;

— Two plants under construction, with combined sunk costs exceeding $300 million, cancelled in the past two years;

— More than 80 previously planned plants deferred or cancelled in the past five years;

— Five orders for new plants placed in the past seven years (compared with over 100 orders in the preceding seven years); and

— No orders for new plants placed in the past three years.

It is clear that nuclear power has reached a hiatus, and perhaps an impasse. This situation can be attributed in part to a reduction in the rate of growth of demand for electricity, to high interest rates, and to keen competition for capital in financial markets. But there are other factors operating as well, as evidenced by the fact that there have been orders for 125,000 MWe of coal-fired capacity in the past seven years, of which 24,000 MWe has been ordered in the past three years."

I chose this opportunity to talk about the need to resolve dilemmas because time has become critical. The conditions under which nuclear power works are deteriorating. The next few years might be the last chance to change course. Preserving that chance depends upon bold, realistic action.

I plan to discuss several critical dilemmas. I want to explain, too, why both the federal government and private industry must devise new concepts and recast roles.

### Recommendations for Action

Actions by the Reagan Administration have been helpful, but hardly more than a bandaid. I believe this is because the present Administration emphasis is not addressing the most fundamental issues with a proper priority. Preoccupation with reprocessing and fast breeder programs is diluting attention. Fast breeder technology, for example, is of little value if the capability to build even a light water reactor is lost.

I believe Mr. Reagan should select two priority items now and promote them above all else. The two are:

1. *Waste disposal*—demonstration of whatever is needed to lessen this obstacle in the public mind.

2. *Government guarantees*—assurance to investors and users that they will not back a project only to find at some future time that the investment is worthless; or to have consumers find that a presumed solution to their electrical needs in the 1990s has evaporated.

In parallel with those government actions it is necessary that industry develop the following:

1. A concept of nuclear power operations under which utility boards of directors would *approve* and financial institutions would *invest* in nuclear projects. Merely being certain that utilities have the needed funds is not enough. Conditions have to be such that the funds will be allocated to nuclear.

2. Advice to the government of those specific conditions the government must establish and the role government must play, in order to spur private industry action.

The urgency of time requires that government and industry actions proceed in parallel.

### The Major Dilemmas

I would like to summarize a number of dilemmas confronting the industry. Most, and perhaps all, urgently require resolution.

### Dilemma Number One: Defining the National Interest

The relationship between advancement of nuclear power and advancement of the national interest is less clearcut than appeared to be the case a few years ago. Both coal and nuclear power appeared essential to meet the next two decades' energy needs. It was thought that neither could handle the job alone.

During the past few years, projected annual growth rates for those two decades have been declining. Forecasts of two to three percent are prevalent. Furthermore, reserve capacity has been holding steady or increasing. The national reserve is about 36 percent.

*COMMENTARY*

roughly twice what is needed. We need to add only six to ten new plants each year during the next decade as we work off some of the excess capacity, if the lower growth forecast proves valid. Coal, if necessary, can meet that need.

Nuclear power has thus moved from an *essential* role to an *optional* role. An essential role has moved farther into the future. We cannot expect nuclear power to be pulled along simply by national interest near term. Coal will have its own problems in time, but does not have barriers now comparable to those of nuclear power.

**Dilemma Number Two:**
**A Separation of Authority and Responsibility**

The federal government has total jurisdiction and total authority over safety. As safety has no hard boundaries, and all overriding cost influences derive from safety criteria, the real determinant of construction and operating cost is the federal government.

The federal government, however, does not share cost responsibility. That falls upon the owners and ratepayers. That division of responsibility and the ever-increasing concern with safety have saddled nuclear utilities with open-ended, financial obligations which few, if any, can afford.

With one exception, all nations which are pushing ahead with nuclear power have government owned utilities. Included are France, Korea, Taiwan and Mexico. The exception, Japan, is noted for close government and industry cooperation. Wherever private utilities prevail, and thus the split of cost responsibilities prevails, as in Sweden, Germany, Switzerland and the United States, nuclear power is stalemated.

This separation gap, I think, is such a critical factor for private utilities that nuclear power in the US will remain at an impasse until legislation provides protection from the consequences of government decisions. Authority and accountability cannot be brought together by transfer of safety authority to private industry. The only solution is to bring cost accountability to the government.

**Dilemma Number Three: Utility Incentive Structures**

It is never totally clear what comprises the national interest or how long a particular definition of that will survive. The definition is political and undergoes constant change. Moreover, the incentive structure—that is, the system of rewards and penalties—imposed on a particular utility may have nothing to do with interests defined at the federal level. For example, at the same time President Reagan is promoting nuclear power, Governor Brown is frustrating it in California. Fuel pass-through provisions, another example, may encourage burning oil rather than bringing in more economical, but higher capital cost nuclear. I doubt that any state or local government incentive structure favors nuclear power.

Unless incentive structures are changed, coherent national policy cannot be implemented. The federal government has little power to change an environment imposed by state and local governments. This dilemma is likely to go unresolved unless the federal government has a commanding, authoritative role as it does, for example, with the Tennessee Valley Authority (TVA). In other words, TVA is much less vulnerable to local problems than other utilities.

Incentive problems are worsened by the knowledge that a utility management can expect all problems of all types to be widely publicized. As long as media communications have negative consequences, utilities will be at odds with a significant fraction of its customers, a bad situation for any business.

**Dilemma Number Four:**
**The Decline of US Supplier Capability**

The US supplier industry capability was built to supply 25 units per year. Current backlog delivery rates are less than half a dozen. Over two dozen plants have been cancelled during the past two years. A dozen more cancellations are expected in the next two. Cancelled capacity is almost as much as the total present operating capacity of all of Western Europe.

By the mid 1980s, supplier capability will reach a critical level. Major equipment manufacturing operations will have been closed. Many second tier suppliers will have withdrawn from the nuclear industry.

A supplier cannot exist indefinitely on a negative order rate regardless of the national interest. Consolidation is unavoidable even assuming the most favorable outlook possible. Probably no more than one supplier can be maintained based on the predicted orders for the next ten to 15 years.

**Delimma Number Five:**
**Mismatches Between Energy Cycles and Political Cycles**

A nuclear plant ordered today would not supply electricity until 1995. The political cycle is far shorter.

*COMMENTARY*

A politician's first need is to get elected. His second need is to get reelected. Those needs occur at intervals of only a few years. Chances for remaining in office are usually enhanced more by decisions producing demonstrable short term benefits than by promotion of the general welfare recognizable 15 years hence.

During design, construction and operation, a utility will face numerous changes in governments. Policies change as governments change. We cannot lengthen government cycles sufficiently to match nuclear project cycles. We cannot shorten project and operating cycles to match political cycles. A bridging mechanism is needed to provide long term stability to a politicized industry.

**Dilemma Number Six: Recognizing A Power Shortage**

How we will respond to an electrical power shortage will depend, first, upon the stage of recognition, and second, upon the time at which we act. What first appears as a need to *alleviate* shortage may turn into a program to *manage* shortage. The first approach may be economic; the second political.

The public does not perceive a need for rapid decisions with respect to the role of nuclear power. No event has occurred recently, or is on the immediate horizon, which is likely to dramatize electrical supply. Apart from a general recognition of a need to reduce oil imports, most electrical generation problems are not visible to the ordinary household.

Any significant political action—and political action is essential—will require both Congressional and Executive Branch actions. Congressional action depends upon public mood. The public mood today encourages the hobbling of nuclear power until perceived safety and waste disposal problems are solved. An Administration effort to make a major leap forward today may be difficult—like attempting the long jump standing in quicksand.

**Dilemma Number Seven: The Uranium Industry**

The uranium industry's fate is wholly dependent upon the nuclear power industry. But special dilemmas concern the uranium industry.

The short term market is somewhat of an anomaly. In a reversal of the usual situation, utility sellers and producer buyers dominate the short term market.

Utilities are contracting for long term needs at a time when public utility commission pressures make it embarrassing to pay above spot prices now, or to accept new contracts which might require paying above the spot price at time of future delivery. Utilities are, therefore, responding to their incentive structures by pressing for contracts which pay market price at time of delivery.

Market price contracts might not be viewed with great uncertainty for most commodities, in which conventional economic forces prevail. But excess uranium inventory selling may continue for some time with pricing dependent upon interest rates, plant schedule delays, and other variables. Conventional economic forecasting may not apply. Not many US producers can afford to accept long term risks. Only very low cost producers are inclined to do so and most are non-US.

The uranium industry is not only surrounded by the general uncertainties of the whole nuclear industry, but with special internal problems of its own.

**Dilemma Number Eight: The Ideological Dilemma**

Solutions for the aforementioned dilemmas may conflict with political ideology. Needed actions depend, unfortunately, upon more government involvement. The ideology of the present Administration, and the public mood as a whole, is towards less government involvement. It would help if nuclear power could somehow be set aside for wholly objective handling, but unfortunately, that is not possible. Solutions tend to evolve out of a stormy political process.

Unfortunately, I do not think the Reagan program can accomplish much that will show visible effects in the short term. I do believe the Administration can have significant long term impacts if a pragmatic approach is taken. Actions may have to run counter to prevailing ideology. A major accomplishment by this Administration and Congress would be the building of a legal and regulatory framework on which a viable industry could develop in subsequent administrations.

**The Magnitude of a Solution**

I have described a series of dilemmas so complex and divisive that they cannot be resolved quickly or simply or within present legal and regulatory frameworks. Major surgery is required.

To illustrate the magnitude of required change, let me mention a few specific conceptual changes I think will be needed. This partial listing is only to illustrate the scope of the challenge.

*First*, the government, especially Congress, will have to decide that active promotion—not passive tolera-

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*COMMENTARY*

tion—of nuclear power is in the national interest. The government will have to take affirmative legal action making it advantageous for *shareholders* and consumers to choose nuclear power over other alternatives.

*Second*, the means provided, as mentioned earlier, must include a system whereby government is accountable for most consequences of government actions. If major new safety criteria are imposed, the government must pay. If a plant is not allowed to operate because the federal government so decrees, the government must pay. Shareholders will not accept open-ended risk when experience has shown that rules continually evolve.

I do not underestimate the difficulty of what I suggest. Government ownership may be the means of last resort. My personal hope is that a formula of government guarantees will be sufficient.

*Third*, new nuclear plants may be located and managed regionally. A dozen or more plants, as is the case in Japan, could be located at each of several remote and self-contained sites. Safety control might be provided locally—that is, at the locus of operations rather than at the political center of Washington, D.C. Federal or regional authority would override state and other local authorities.

As you have noted, there is little resemblance between what is required and what exists. Merely establishing the groundwork requires five to ten years.

**Conclusion**

The changes I have outlined require bold action. There is little point, in my view, of further studies. We know what has to be done. The problem is agreement upon the means to the needed ends.

Unless bold action is taken to reshape the economic and political environment, we will continue on the present course of disintegration. The uranium industry, as one example, must confine future expectations to plants in operation, and some fraction of those now listed as committed or in progress. Until there is a strong move forward, concrete evidence of a government framework encouraging a new, practical concept and a consensus as to desirability and practicality, a very, very conservative investment view is to be expected.

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## KEY LAKE PROJECT — PART III

### Regional Geology

The important uranium deposits of northern Saskatchewan are located along the outer perimeter of the Athabasca Basin. The Cluff Lake deposit is the one exception. The Key Lake orebodies are situated on the southeastern part of the basin rim. Uranium mineralization is known to occur in two different host rocks—quartzites and conglomerates of the Athabasca Formation, and the underlying metamorphosed and altered sediments of the Wollaston Fold Belt. The Athabasca Formation correlates to the Helikian Era of Middle Proterozoic age; the Wollaston Fold Belt relates to the Aphebian Era of Lower Proterozoic age and Archean basement rocks of Early Precambrian. The structural and stratigraphic relationship of the host formations was an important factor in emplacement of the uranium mineralization. Table 7 shows the time correlation between stratigraphic and orogenic events for the area of interest in northern Saskatchewan.

**Table 7**

**GENERALIZED STRATIGRAPHIC AND OROGENIC TIME CORRELATION CHART OF THE GEOLOGY OF NORTHERN SASKATCHEWAN**

| Geologic Period | Event Formation Orogeny | Age Estimate (millions of years) |
|---|---|---|
| | Quaternary Uplift | |
| Cenozoic | Pleistocene | ~2 |
| | Deposition | |
| Middle Proterozoic | Helikian Era | 1650-1500 |
| | Athabasca FM | 1350 plus |
| | Regolith | 1630 plus |
| Lower Proterozoic | HUDSONIAN OROGENY | 1735 |
| | Aphebian ERA | 1850-1700 |
| | Wollaston Fold Belt | 2480-1700 |
| Archean | KENORAN OROGENY | 2480 plus |
| | Wollaston Fold Belt | 2500 plus |
| | Basement | 2500 plus |

The rocks of the Wollaston Fold Belt were deposited during two periods of early geologic history. The oldest segment is that of Archean basement, consisting of great thicknesses of sedimentary and volcanic rocks intruded by granites. The entire sequence was faulted, folded and metamorphosed during the late Archean Kenoran Orogeny. Granite intrusions continued throughout the orogenesis. Erosion and rock alteration continued from the close of the Kenoran Orogeny to the beginning of the Lower Proterozoic period and the Aphebian Era.

The identifiable rocks of Archean age include granites, biotite and graphitic gneisses, and infolded metamorphosed and altered sediments. Although the rocks are predominantly granite, the metamorphosed and altered sequence shows a broad distribution of coarse to fine-grained rock units. The finer grained material, referred to as metapelites, may contain large amounts of graphite distributed throughout or present as distinguishable intercalated graphitic horizons. The graphitic pelites and the biotite and graphitic gneisses commonly contain abnormal amounts of uranium, especially in association with highly fractured and altered rocks adjacent to prominent fault zones.

Aphebian rocks were deposited unconformably on the Archean rocks. There was large variation in the deposition of the Aphebian sequence. Sandstones, conglomerates, siltstones and some limestones made up much of the sedimentary series. Volcanic flow rocks were dispersed throughout the formation. The entire sequence was subject to metamorphism, faulting and considerable infolding with Archean rocks during the Hudsonian Orogeny which occurred in late Aphebian time. Erosion was again intense following the second orogenesis.

The deposition of Aphebian rocks was influenced by the undulating and linear structural features (northeast-southwest trend) of the Archean rocks. The basal conglomerates and sandstones filled the synclinal troughs to form massive units which were metamorphosed and folded during the Hudsonian Orogeny. The metamorphic series primarily consists of chlorite and graphitic gneisses, and schists, both of which contain anomalous uranium mineralization.

The upper portion of the Aphebian was made up of thick calcium-rich quartzites which experienced extensive weathering and erosion during the long period that ended the Hudsonian Orogeny. The present surface features are much the same as they were at the

end of the Aphebian period—specifically, northeast-southwest lineation along prominent fault and fold belts and north-south faulting. The subsequent development of basins as a result of settling by Archean basement rocks was probably one of the last important structural events (Hudsonian) to affect the Wollaston Fold Belt.

The Aphebian surface was highly weathered and altered to form a regolith mantle that varies in thickness from a few feet to tens of feet. The deposition of Helikian age sediments followed the Aphebian Era to lie unconformably on the regolith mantle. The broad basins and linear troughs were filled by fluvial sediments of the Martin Formation and the Athabasca Formation. However, the Athabasca Basin was filled entirely by the Athabasca Formation which consists of quartzites eroded from the upper portion of Aphebian rocks. The formation contains basal quartz-pebble conglomerates covered by well sorted and evenly bedded quartzites. A few thin shale beds occur at random throughout the formation. Total formation thickness is about 5,500 feet at the basin center, thinning rapidly to an erosional wedge toward the outer perimeters. Evidence of structural changes in the formation relate to north-south faulting, primarily in the eastern half of the basin; the intrusion of northwest-southeast trending diabase dikes cutting through the southwestern portion; and regional uplifting during Quaternary time which caused extensive erosion of Athabasca sediments to expose the unconformity and the Wollaston Fold Belt rocks, the principal host environment for uranium mineralization.

**Uranium Mineralization**

The occurrence of uranium mineralization in the Athabasca region is related to pre-Hudsonian orogenesis of Aphebian rocks and lithologic characteristics of the overlying Helikian sediments. Important concentrations of uranium occur in altered brecciated and mylonite zones along major faults in Aphebian rocks, and in the fractures and fissures of lower Athabasca sediments. The host environment for high-grade ore (values exceeding one percent $U_3O_8$) is predominantly fault-related fissures and shear zones in the highly altered kaolinitic and choloritic mylonites of upper Aphebian rocks. The main host for the mineralization is the kaolinitic mylonite.

Uranium ore minerals are primarily pitchblende and sooty pitchblende, both uranium oxides, and coffinite which is a uranium silicate. The two latter minerals are replacement products of pitchblende. The predominant mineral in the Aphebian rocks is pitchblende. It occurs exclusively in the deeper shears of less altered rocks, grading to sooty pitchblende and coffinite in the upper altered rocks. Uranium minerals in the Athabasca Formation are limited to sooty pitchblende and coffinite, of which coffinite is the most abundant.

Nickel minerals occur in association with uranium at Key Lake. Gersdorffite and millerite are the most abundant of the five nickel minerals present. Both occur throughout the uranium mineralization with high-grade nickel (up to 20 percent), coinciding with high-grade uranium. However, nickel is known to occur to greater depths in the basement as compared to the uranium. Other metals which are present in trace amounts throughout the important zones of mineralization include galena, gold and selenium.

There are several theories concerning the origin of the uranium deposits. In one accepted theory, the uranium is included as a constituent in the sediments at the time of deposition of the Wollaston Fold Belt series. Hydrothermal and metamorphic activity, associated with the Hudsonian Orogeny, allowed uranium-bearing groundwater to pass through the oxidized rocks. The uranium was recrystallized and or remobilized and deposited in a more concentrated form in structural traps of the Wollaston Fold Belt rocks. The time sequence for these mineralizing events is approximately 1900 to 1350 millions of years.

Uranium deposition in the Athabasca Formation is limited to the basal units and the unconformity. Further remobilization of uranium in the older rocks resulted in the concentration of ore along fault zones and on fractures in the lower Athabasca units. The age of mineralization is estimated at 1350 to 200 millions of years. Sooty pitchblende and coffinite were developed during the last stage of mineralization. Generally, the mineralizing process occurred throughout several prolonged periods of hydrothermal alteration and remobilization of the minerals, with the greatest movement and concentration of mineralization occurring during the events of 1350 to 200 millions of years.

**Orebody Geology**

The two uranium deposits at Key Lake are situated less than one mile apart on a common structural feature. It is probable that the Gaertner and Deilmann

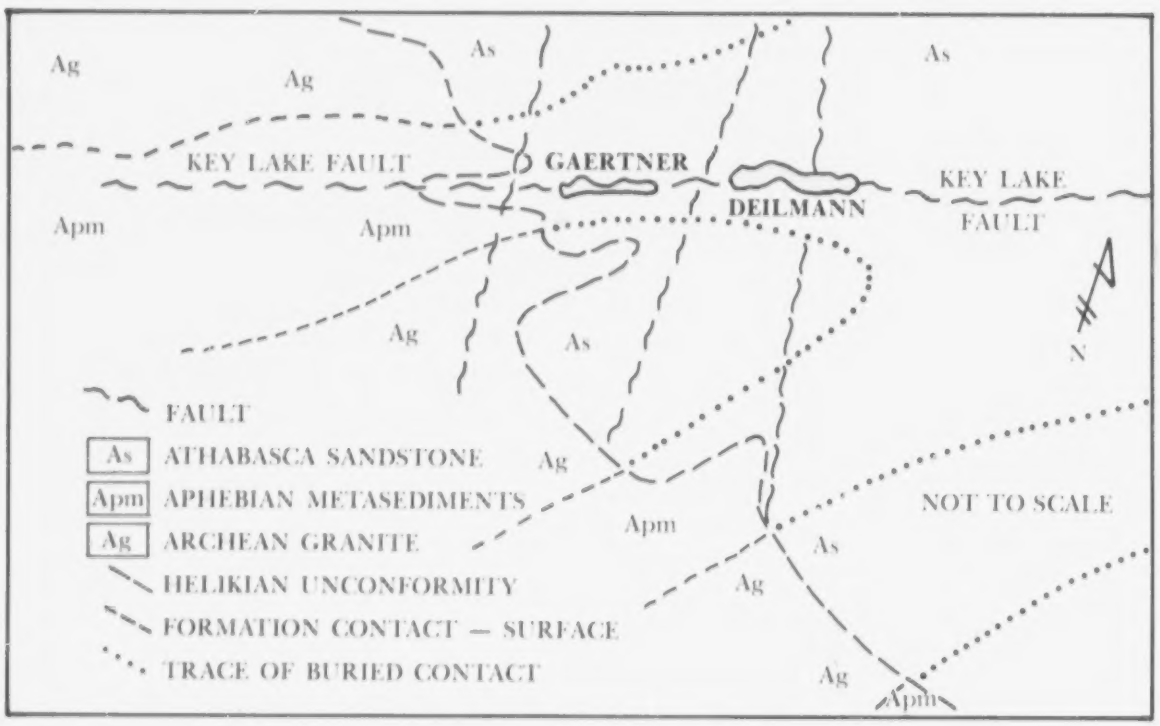


**Figure 1**
**GENERALIZED GEOLOGIC MAP OF THE KEY LAKE URANIUM DISTRICT**

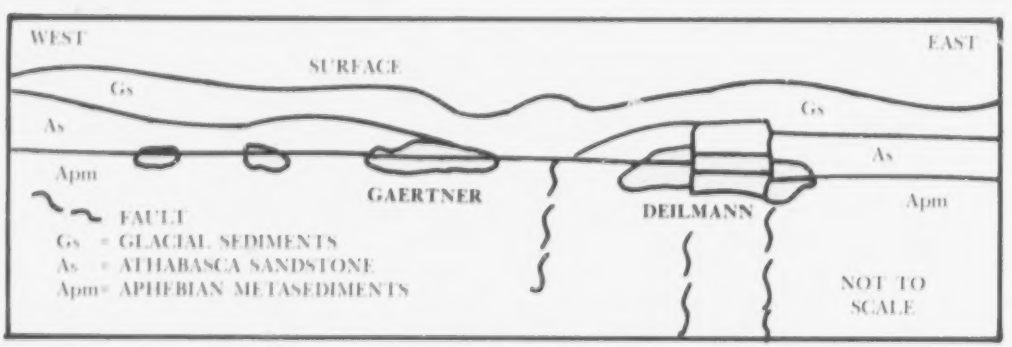


**Figure 2**
**GENERALIZED LONGITUDINAL SECTION THROUGH THE GAERTNER & DEILMANN URANIUM DEPOSITS, KEY LAKE PROJECT**

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orebodies originally formed one ore zone and are now separated as a result of Quaternary erosion. Athabasca sediments have been completely eroded away between the orebodies, and glacial sediments lie unconformably on Aphebian rocks. A few small satellite orebodies occur along the same structural feature, or within parallel structures that are compatible with the main zone.

The main orebodies are restricted to the Key Lake fault zone which is the predominant northeast-southwest trending structure in the district. The zone actually consists of multiple parallel faults conforming to the pattern of lineation that developed during the Hudsonian Orogeny. The faulting evolved along one of the thicker graphitic metapelites zones and created displacement of tens of meters in the Aphebian rocks. Movement along the fault zone continued into the Middle Proterozoic Period as expressed by post-Hudsonian displacement of Athabasca sediments at the unconformity. Figure 1 is a generalized geologic map of the Key Lake area.

Uranium mineralization is concentrated along the Key Lake fault zone in veins and shears of deeply altered Aphebian rocks, at the unconformity, and in the lower units of Athabasca sediments. North-northeast faulting which is post-Key Lake faulting, cut through the main structural zone to further displace all host rocks, and influence emplacement of ore, especially during later mineralizing periods. However, the greatest quantity of ore occurs along the central area of the Key Lake fault zone where brecciation and mylonitization has been most intense. The breccia zone consists of fragments of both Athabasca sediments and Aphebian rocks which have been altered completely to kaolinite and chlorite. In this environment, the minerals fill the shears and fissures in depth and develop into large irregular orebodies at the sub-Athabasca unconformity. Mineralization is restricted to fractures in the lower units of the Athabasca Formation.

The importance of the unconformity and the fault patterns to mineralization is supported by the fact that all minable uranium is concentrated within a zone about one hundred meters below and only a few meters above the conformity. More precisely, the Gaertner orebody has a maximum width of 90 meters and extends vertically only about 60 meters; the measurements of the Deilmann orebody are 200 meters and 120 meters respectively. Figure 2 is a generalized longitudinal section of the two Key Lake deposits.

**Summary**

The main ore control for the Key Lake deposits is related to the pre-Hudsonian tectonic and sedimentary environment. Uranium-rich sediments were deposited, later metamorphosed, and altered to develop local concentrations of uranium as the first stage of mineralization. Prolonged hydrothermal and tectonic activity caused remobilization and/or recrystallization. This was followed by precipitation of uranium during Hudsonian orogenesis, resulting in additional concentration of uranium in the favorable host environment of Aphebian rocks. The mineralizing process continued into post-Hudsonian time to further enrich the veins and shear zones at the sub-Helikian unconformity and in fractures of the lower Athabasca quartzites. The age of mineralization (estimated from about 1900 to 200 millions of years) indicates that the mineralizing process occurred throughout several distinct episodes of geologic history. The fact that remobilization of uranium is continuing to a limited degree is supported by the anomalous radioactivity that lead to the discovery of uranium deposits in the Key Lake area.

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*STATISTICAL DATA*

**EXCHANGE VALUE $23.50/lb. $U_3O_8$**
Determined as of November 30, 1981

**Definition**

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

**Derivation**

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

**Comments**

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.

B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

**TRANSACTION VALUE**
Determined as of November 30, 1981

| $/lb $U_3O_8$ | Millions of Pounds | Number of Transactions | Number of Months |
|---|---|---|---|
| 24.10 | 2.1 | 10 | 3 |

**Definition**

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for $U_3O_8$ in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds $U_3O_8$ are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

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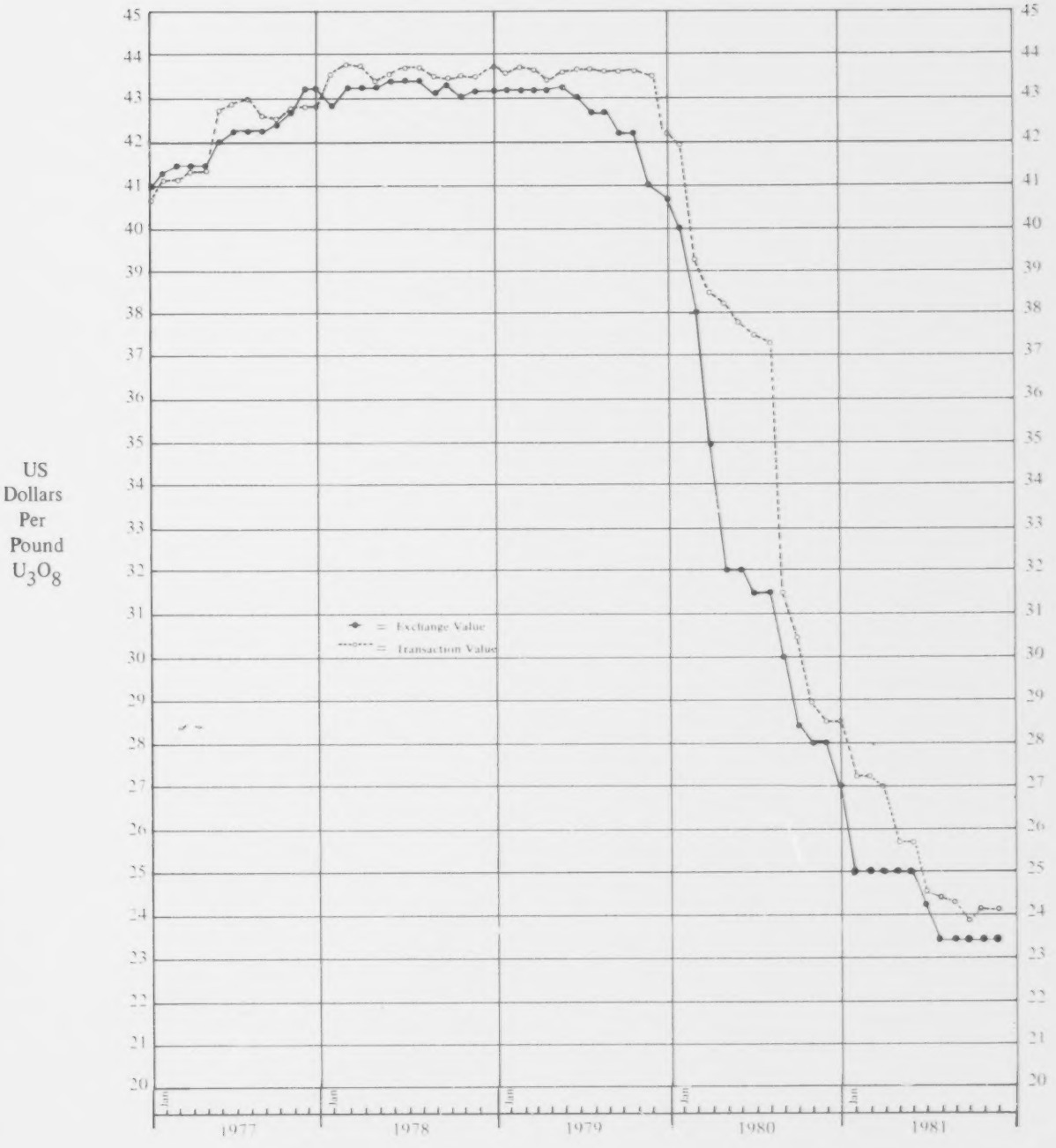
*STATISTICAL DATA*

## EXCHANGE AND TRANSACTION VALUES
## SINCE JANUARY 1977
Determined as of the last day of the month indicated

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*STATISTICAL DATA*

## HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars lb. $U_3O_8$)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1968 | – | – | – | – | – | – | – | 6.35 | 6.35 | 6.40 | 6.45 | 6.50 |
| 1969 | – | 6.35 | 6.10 | 6.10 | 6.25 | 6.25 | 6.20 | 6.20 | 6.15 | 6.15 | 6.15 | 6.20 |
| 1970 | 6.30 | 6.30 | 6.30 | 6.30 | 6.30 | 6.30 | 6.30 | 6.20 | 6.15 | 6.15 | 6.15 | 6.15 |
| 1971 | 6.20 | 6.20 | 6.20 | 6.20 | 6.15 | 6.05 | 6.00 | 5.95 | 5.95 | 5.95 | 5.95 | 5.95 |
| 1972 | 5.95 | 5.95 | 5.95 | 5.95 | 5.95 | 5.95 | 5.95 | 5.95 | 5.95 | 5.95 | 5.95 | 5.95 |
| 1973 | 5.95 | 6.00 | 6.10 | 6.20 | 6.45 | 6.50 | 6.50 | 6.50 | 6.50 | 6.50 | 6.75 | 7.00 |
| 1974 | 7.70 | 7.90 | 8.00 | 9.00 | 9.50 | 10.50 | 11.50 | 12.00 | 12.50 | 14.00 | 14.75 | 15.00 |
| 1975 | 16.00 | 16.00 | 18.00 | 20.00 | 21.00 | 23.00 | 24.70 | 26.00 | 26.00 | 28.50 | 30.00 | 35.00 |
| 1976 | 35.20 | 37.00 | 39.25 | 40.00 | 40.00 | 40.00 | 40.00 | 40.40 | 41.00 | 41.00 | 41.50 | 41.00 |
| 1977 | 41.35 | 41.50 | 41.60 | 41.60 | 42.00 | 42.25 | 42.25 | 42.25 | 42.40 | 42.75 | 43.20 | 43.20 |
| 1978 | 42.90 | 43.25 | 43.25 | 43.25 | 43.40 | 43.40 | 43.40 | 43.10 | 43.25 | 43.00 | 43.25 | 43.25 |
| 1979 | 43.25 | 43.25 | 43.25 | 43.25 | 43.25 | 43.00 | 42.70 | 42.70 | 42.20 | 42.20 | 41.00 | 40.75 |
| 1980 | 40.00 | 38.00 | 35.00 | 32.00 | 32.00 | 31.50 | 31.50 | 30.00 | 28.50 | 28.00 | 28.00 | 27.00 |
| 1981 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 24.25 | 23.50 | 23.50 | 23.50 | 23.50 | 23.50 | |

## HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars lb. $U_3O_8$)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1976 | – | – | – | – | 39.60 | 39.70 | 39.70 | 40.40 | 40.30 | 40.60 | 40.70 | 40.70 |
| 1977 | 41.30 | 41.30 | 41.40 | 41.50 | 42.80 | 42.90 | 43.00 | 42.60 | 42.50 | 42.80 | 42.90 | 42.90 |
| 1978 | 43.10 | 43.30 | 43.70 | 43.60 | 43.60 | 43.20 | 43.30 | 43.40 | 43.40 | 43.60 | 43.40 | 43.70 |
| 1979 | 43.60 | 43.80 | 43.70 | 43.40 | 43.60 | 43.70 | 43.70 | 43.60 | 43.60 | 43.60 | 43.50 | 42.30 |
| 1980 | 42.00 | 39.30 | 38.60 | 38.40 | 37.90 | 37.60 | 37.30 | 31.60 | 30.60 | 29.00 | 28.70 | 27.70 |
| 1981 | 27.20 | 27.20 | 27.00 | 25.70 | 25.70 | 24.50 | 24.40 | 24.30 | 23.90 | 24.10 | 24.10 | |

## EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES*

| Country | per lb $U_3O_8$ in Concentrates | per kg $U_3O_8$ in Concentrates | per kg U in Concentrates |
|---|---|---|---|
| US (dollar) | 23.50 | 51.81 | 61.09 |
| France (franc) | 131.21 | 289.27 | 341.12 |
| FRG (mark) | 52.00 | 114.65 | 135.20 |
| Japan (yen) | 5,065 | 11,166 | 13,167 |
| Switzerland (franc) | 41.67 | 91.88 | 108.34 |
| UK (pound) | 12.01 | 26.47 | 31.21 |
| Australia (dollar) | 20.42 | 45.01 | 53.08 |
| Canada (dollar) | 27.66 | 60.98 | 71.91 |
| Niger, Gabon (CFA) | 6,528 | 14,391 | 16,971 |
| South Africa (rand) | 22.65 | 49.94 | 58.89 |
| Sweden (kröner) | 128.42 | 283.11 | 333.85 |

*Calculated using currency exchange rates published in the Wall Street Journal on the last business day of the month.

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*STATISTICAL DATA*

**CONVERSION VALUE $1.20/lb. U as $UF_6$**
Determined as of November 30, 1981

**Definition**

The Conversion Value is Nuexco's judgment of the price at which spot and or near term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

**Derivation**

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.

B. Data from pending transactions.

C. Firm bids to buy and firm offers to sell.

D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

**Comments**

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.

B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.

**LOAN USE CHARGE RATE 6%**
Determined as of November 30, 1981

**Definition**

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

**Derivation**

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.

B. Rates included in firm proposals to borrow or lend.

C. Rates that potential borrowers and lenders have expressed as a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

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*STATISTICAL DATA*

## CURRENT TRANSACTIONS*

### Uranium Transactions

| Nuexco Reference Number | Delivery Period | Approximate Quantity (thousands of pounds, $U_3O_8$ equivalent) | Approximate Price as percent of Current E.V. | Seller Group | Buyer Group | Remarks |
|---|---|---|---|---|---|---|
| 1650 | 1981 | 50 to 100 | 99 | US | US | |

### Conversion Transactions

| Nuexco Reference Number | Delivery Period | Approximate Quantity (thousands of pounds, U equivalent) | Approximate Price as percent of Current C.V. | Seller Group | Buyer Group | Remarks |
|---|---|---|---|---|---|---|

none reported

*Transactions listed include not only those in which Nuexco was involved, but also all others of which Nuexco is aware.

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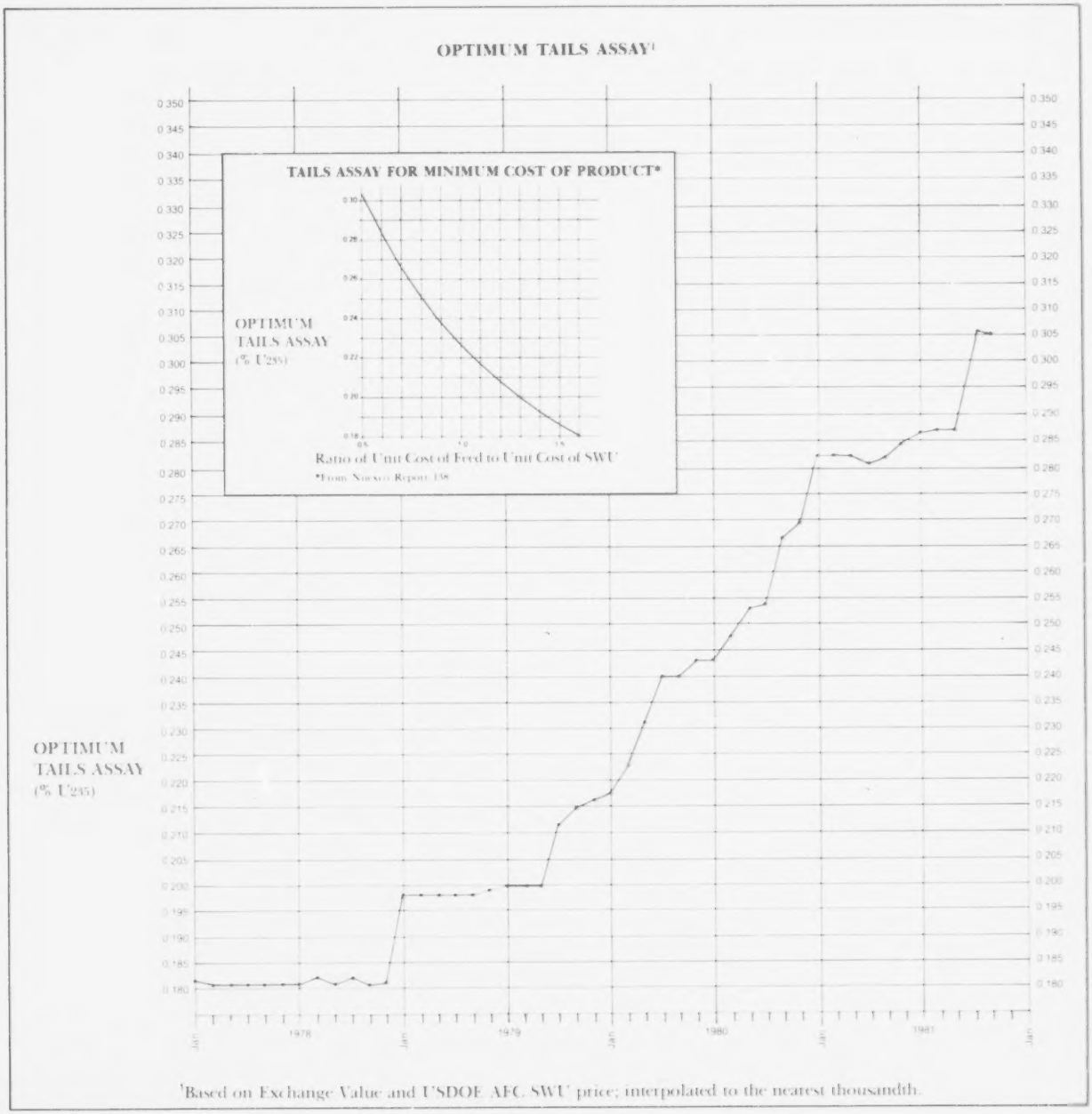
## OPTIMUM TAILS ASSAY

The optimum tails assay is the tails composition at which the cost of enriched uranium is lowest for given costs of separative work (SWU) and natural uranium feed. It depends only on the ratio of the cost of a kilogram of natural uranium in the form of $UF_6$ to the cost of a kilogram unit of separative work. Holders of US Department of Energy (USDOE) Adjustable Fixed Commitment (AFC) enrichment contracts have the option to specify, within limits, the transaction tails assay. The transaction tails assay for USDOE Requirements contracts is 0.2 percent $U_{235}$. For every one-hundredth of one percent increase in the transaction tails assay, natural uranium consumption increases about two percent.




[1]Based on Exchange Value and USDOE AFC SWU price; interpolated to the nearest thousandth.

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*STATISTICAL DATA*

## US GOVERNMENT STATISTICS

| | Producer Price Index—Industrial Commodities (1967 = 100)[1] | Producer Price Index—All Commodities (1967 = 100)[1] | Consumer Price Index (1967 = 100)[2] | GNP Implicit Price Deflator (1972 = 100)[3] | Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4] | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Metal Mining (SIC 10) | Primary Non-ferrous Metals (SIC 333) | Chemicals and Allied Products (SIC 28) | Electric and Electronic Equipment (SIC 36) |
| Annual Avg. 1970[5] | 110.0 | 110.4 | 116.3 | 91.36 | 3.88 | 3.87 | 3.69 | 3.28 |
| Annual Avg. 1971[5] | 114.1 | 114.0 | 121.3 | 96.02 | 4.12 | 4.15 | 3.97 | 3.49 |
| Annual Avg. 1972[5] | 117.9 | 119.1 | 125.3 | 100.00 | 4.56 | 4.59 | 4.26 | 3.71 |
| Annual Avg. 1973[5] | 125.9 | 134.7 | 133.1 | 105.80 | 4.84 | 4.98 | 4.51 | 3.91 |
| Annual Avg. 1974[5] | 153.8 | 160.1 | 147.7 | 116.02 | 5.44 | 5.63 | 4.88 | 4.21 |
| Annual Avg. 1975[5] | 171.5 | 174.9 | 161.2 | 127.15 | 6.13 | 6.24 | 5.39 | 4.64 |
| Annual Avg. 1976[5] | 182.4 | 183.0 | 170.5 | 133.71 | 6.76 | 6.87 | 5.91 | 4.96 |
| Annual Avg. 1977[5] | 195.1 | 194.2 | 181.5 | 141.70 | 7.28 | 7.67 | 6.43 | 5.39 |
| Annual Avg. 1978[5] | 209.4 | 209.3 | 195.4 | 152.05 | 8.23 | 8.56 | 7.02 | 5.82 |
| Annual Avg. 1979[5] | 236.5 | 235.6 | 217.4 | 165.46 | 9.27 | 9.50 | 7.60 | 6.32 |
| Annual Avg. 1980[5] | 274.8 | 268.8 | 246.8 | 177.36 | 10.27 | 10.63 | 8.30 | 6.95 |
| Jun 1980 | 273.5 | 265.6 | 247.6 | 178.93 | 10.14 | 10.70 | 8.25 | 6.86 |
| Jul 1980 | 276.2 | 270.4 | 247.8 | — | 10.24 | 10.83 | 8.36 | 6.95 |
| Aug 1980 | 278.2 | 273.8 | 249.4 | — | 10.39 | 10.79 | 8.40 | 7.01 |
| Sep 1980 | 278.8 | 274.6 | 251.7 | 182.92 | 10.55 | 10.95 | 8.47 | 7.12 |
| Oct 1980 | 282.2 | 277.8 | 253.9 | — | 10.59 | 11.01 | 8.53 | 7.18 |
| Nov 1980 | 283.4 | 279.1 | 256.2 | — | 10.73 | 11.07 | 8.60 | 7.27 |
| Dec 1980 | 286.6 | 280.8 | 258.4 | 183.98 | 10.84 | 11.32 | 8.69 | 7.38 |
| Jan 1981 | 291.5 | 284.8 | 260.5 | — | 10.91 | 11.31 | 8.74 | 7.41 |
| Feb 1981 | 295.7 | 287.6 | 263.2 | — | 11.15 | 11.36 | 8.80 | 7.43 |
| Mar 1981 | 299.6 | 290.3 | 265.1 | 188.14 | 11.13 | 11.50 | 8.84 | 7.47 |
| Apr 1981 | 303.5 | 293.4 | 266.8 | — | 11.30 | 11.63 | 8.91 | 7.51 |
| May 1981 | 304.7R | 294.1R | 269.0 | — | 11.26 | 11.68 | 8.99 | 7.55 |
| Jun 1981 | 305.1R | 294.8R | 271.3 | 191.06 | 11.31 | 11.88 | 9.07 | 7.60 |
| Jul 1981 | 306.0P | 296.0P | 274.4 | — | 11.61 | 12.19 | 9.16 | 7.69 |
| Aug 1981 | 307.0P | 296.2P | 276.5 | — | 11.85R | 12.09R | 9.19R | 7.76P |
| Sep 1981 | 307.2P | 295.5?P | 279.3 | 195.44R | 12.12P | 12.95P | 9.38R | 7.79R |
| Oct 1981 | 308.8P | 296.0P | 279.9 | — | — | — | 9.32P | 7.78P |

P = Preliminary R = Revised since last month

[1]US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.

[2]US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.

[3]US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table A. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.

[4]US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for 1977-1978 are adjusted to the March 1979 benchmark. Data for January 1979 and beyond are adjusted to the March 1980 benchmark.

[5]Monthly data 1970-1978 for Producer Price Index-Industrial Commodities, Consumer Price Index, and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNMP Implicit Price Deflator appear on pages 4.6-4.8 of Nuexco Report 139.
Monthly data 1977-1978 for Employment and Earnings SIC Codes 10, 333, and 28 appear on page 33 of Nuexco Report 147.
Monthly data 1970-1978 for Employment and Earnings SIC Code 36 appear on page 23 of Nuexco Report 154.
Monthly data 1979-1980 for Employment and Earnings, Revised Establishment Data, all listed codes, appear on page 22 of Nuexco Report 158.
Monthly data 1977-1980 for Producer Price Index-All Commodities, appear on page 21 of Nuexco Report 158.

*STATISTICAL DATA*

## AUSTRALIAN GOVERNMENT STATISTICS

| | Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1] | Weighted Average Minimum Weekly Wage Rates—Adult Males Australia Mining and Quarrying (A$)[2] |
|---|---|---|
| Annual Avg. 1970[3] | 101.4 | 59.88 |
| Annual Avg. 1971[3] | 101.5 | 65.95 |
| Annual Avg. 1972[3] | 105.6 | 71.26 |
| Annual Avg. 1973[3] | 124.4 | 78.96 |
| Annual Avg. 1974[3] | 141.9 | 108.07 |
| Annual Avg. 1975[3] | 150.4 | 132.55 |
| Annual Avg. 1976[3] | 168.4 | 160.93 |
| Annual Avg. 1977[3] | 192.0 | 179.03 |
| Annual Avg. 1978[3] | 198.5 | 190.04 |
| Annual Avg. 1979 | 248.8 | 196.34 |
| Annual Avg. 1980 | 321.8 | 217.96 |
| Jul 1980 | 347.8 | 221.52 |
| Aug 1980 | 352.0 | 220.08 |
| Sep 1980 | 350.3 | 219.60 |
| Oct 1980 | 348.2 | 221.13 |
| Nov 1980 | 350.4 | 221.50 |
| Dec 1980 | 351.7 | 221.81 |
| Jan 1981 | 357.8 | 229.97 |
| Feb 1981 | 356.6 | 229.79 |
| Mar 1981 | 355.2 | 229.04 |
| Apr 1981 | 354.6 | 228.76 |
| May 1981 | 353.4 | 236.67 |
| Jun 1981 | 360.4 | 236.99 |
| Jul 1981 | 357.5 | 236.85 |
| Aug 1981 | 360.3R | 236.85P |
| Sep 1981 | 357.8P | 236.82P |

P = Preliminary R = Revised since last month

[1]Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.
[2]Australian Bureau of Statistics, Canberra: "Wage Rates, Australia" (Catalogue No. 6312.0), Table 1. Figures for the latest fourteen months shown are subject to revision.
[3]Monthly data for 1970 through 1978 appear on pages 1.7 and 1.8 of Nuexco Report 138.

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*STATISTICAL DATA*

## CANADIAN GOVERNMENT STATISTICS

| | Industry Selling Price Index: Manufacturing (D 500000)[1] [2] (1971 = 100.0) | Wage-earner Data: Average Hourly Earnings (C$)[3] [4] | | |
|---|---|---|---|---|
| | | Metal Mining, including milling (SIC 050-059) | Primary Metal Industries, non-ferrous (SIC 296-298) | Chemicals and Chemical Products (SIC 370-379) |
| Annual Avg. 1977 | 174.3 | 8.18 | 6.50 | 6.51 |
| Annual Avg. 1978 | 190.4 | 8.76 | 6.82 | 6.97 |
| Annual Avg. 1979 | 217.9 | 9.60 | 7.35 | 7.67 |
| Annual Avg. 1980 | 247.2 | 10.59 | 8.05 | 8.50 |
| Jul 1980 | 246.3 | 10.49 | 8.11 | 8.55 |
| Aug 1980 | 249.4 | 10.58 | 8.14 | 8.65 |
| Sep 1980 | 252.0 | 10.85 | 8.24 | 8.71 |
| Oct 1980 | 256.0 | 11.05 | 8.28 | 8.82 |
| Nov 1980 | 257.8 | 11.11 | 8.38 | 8.77 |
| Dec 1980 | 258.4 | 11.13 | 8.32 | 8.92 |
| Jan 1981 | 263.3 | 11.27 | 8.51 | 8.90 |
| Feb 1981 | 263.7 | 11.43 | 8.59 | 9.00 |
| Mar 1981 | 265.7R | 11.47 | 8.63 | 9.17 |
| Apr 1981 | 268.1R | 11.73 | 8.76 | 9.33 |
| May 1981 | 270.1R | 11.80 | 8.90 | 9.49 |
| Jun 1981 | 272.4R | 11.80 | 9.16R | 9.57R |
| Jul 1981 | 274.3R | 11.92P | 9.20P | 9.58P |
| Aug 1981 | 276.1R | 11.79P | 9.15P | 9.62P |
| Sep 1981 | 276.9P | — | — | — |

P = Preliminary R = Revised since last month

[1]Statistics Canada, Prices Division, Ottawa; "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.
[2]Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.
[3]Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa; "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.
[4]Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

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*STATISTICAL DATA*

## REPUBLIC OF SOUTH AFRICA STATISTICS

| | Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1] | Consumer Price Index[2] (1975 = 100, except where otherwise indicated) | Wholesale Price Index All Groups (1975 = 100) | Total Employment in Mining and Quarrying (Code 35)[3] | Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[3] |
|---|---|---|---|---|---|
| Annual Avg. 1970[5] | 7.34 | 100.3[4] | | 655,346 | 399,164 |
| Annual Avg. 1971[3] | 7.88 | 106.4[4] | 59.1 | 652,294 | 415,956 |
| Annual Avg. 1972[3] | 8.79 | 113.3[4] | 63.9 | 623,067 | 443,933 |
| Annual Avg. 1973[3] | 10.51 | 124.1[4] | 72.3 | 684,743 | 572,133 |
| Annual Avg. 1974[3] | 13.18 | 138.5[4] | 85.3 | 674,140 | 761,596 |
| Annual Avg. 1975[3] | 16.71 | 157.2[4] | 100.0 | 639,473 | 1,003,617 |
| Annual Avg. 1976[3] | 19.30 | 174.7[4] | 115.1 | 671,240 | 1,212,983 |
| Annual Avg. 1977[3] [6] | 23.87 | 194.4[4] | 130.0 | 712,006 | 1,420,670 |
| Annual Avg. 1978[3] [6] | 27.14 | 137.2 | 142.7 | 664,571 | 1,537,169 |
| Annual Avg. 1979[3] [6] | 30.18 | 155.3 | 164.5 | 692,209 | 1,830,632 |
| Annual Avg. 1980[6] | 35.53 | 176.7 | 192.1 | 714,379 | 2,279,615 |
| Jul 1980 | — | 177.2 | 192.7 | 715,460 | 202,463 |
| Aug 1980 | — | 179.2 | 196.8 | 716,486 | 206,514 |
| Sep 1980 | 36.19 | 182.8 | 199.8 | 710,889 | 204,761 |
| Oct 1980 | — | 186.3 | 203.1 | 720,246 | 204,602 |
| Nov 1980 | — | 187.8 | 205.6 | 716,797 | 208,345 |
| Dec 1980 | 37.69 | 189.9 | 206.5 | 705,087 | 211,829 |
| Jan 1981 | — | 191.0 | 207.2 | 729,575 | 219,969 |
| Feb 1981 | — | 193.8 | 209.8 | 725,647 | 210,275 |
| Mar 1981 | 39.26 | 195.2 | 209.9 | 705,010 | 210,151 |
| Apr 1981 | — | 196.4 | 211.6 | 719,674 | 217,124 |
| May 1981 | — | 197.7 | 213.2 | 726,869 | 219,880 |
| Jun 1981 | 40.41 | 200.0 | 215.3 | 728,506 | 237,049 |
| Jul 1981 | — | 204.6 | 218.4 | 735,839 | 249,080 |
| Aug 1981 | — | 208.0 | 222.6 | 722,684 | 245,817 |
| Sep 1981 | — | — | 227.0 | — | — |

[1]Chamber of Mines of South Africa, Johannesburg. "Analysis of Working Results," published quarterly.
[2]Republic of South Africa Department of Statistics, Pretoria. "Government Gazette: Consumer Price Index for Urban Areas."
[3]Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 19 of Nuexco Report 140.
[4]April 1970 = 100.00.
[5]Bulletin of Statistics, Department of Statistics, Pretoria.
[6]Historical data for Codes 35 and 40 1977-1980 appear on page 28 of Nuexco Report 157.

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